JOINT HIGHWAY RESEARCH PROJECT

ENGINEERING SOILS MAP OF BOONE COUNTY

PURDUE UNIVERSITY
INDIANA STATE HIGHWAY COMMISSION

Final Report

ENGINEERING SOILS MAP OF BOONE COUNTY

TO:	J. F. McLaughlin, Director Joint Highway Research Project	December 1, 1975 Project: C-36-51B
FROM:	H. L. Michael, Associate Director Joint Highway Research Project	File: 1-5-2-57

The attached report, entitled "Engineering Soils Map of Boone County, Indiana," completes a portion of the project concerned with development of county engineering soils maps of the State of Indiana. This is the 55th report in the series. The report was prepared by Professor D. G. Shurig, Joint Highway Research Project.

The soils mapping of Boone County was performed primarily by using the soil survey map sheets published by the Soil Conservation Service, United States Department of Agriculture in the soil survey of Boone County. Airphoto interpretation techniques were used to supplement the pedological data. The resulting engineering soils map is presented as a blackline print.

Respectfully submitted,

Harold L. Michael

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Associate Director

HLM:bjp

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Final Report

ENGINEERING SOILS MAP OF BOONE COUNTY

by

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Research Associate

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Project No.: C-36-51B

File No.: 1-5-2-57

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with the

Indiana State Highway Commission

Purdue University
West Lafayette, Indiana
December 1, 1975

ENGINEERING SOILS MAP

OF

BOONE COUNTY, INDIANA

INTRODUCTION

Development of an engineering soils map of Boone County was the primary goal of this project. The map is appended to this report; the report supplements the engineering soils map information.

The detailed pedological soils maps published in the 1975 Soil Survey of Boone County by the United States Department of Agriculture Soil Conservation Service in cooperation with the Purdue University, Agricultural Experiment Station (3) were the single most important source of data used in the project. These agricultural soils map sheets, at a scale of 1:15,840, were assembled to form a mosaic map of Boone County. Careful study of the soil series descriptions enabled the grouping of the series into appropriate land form and parent material categories. Preliminary land form and parent material boundaries were then delineated on the mosaic map.

Routine airphoto interpretation techniques supplemented the pedological data. Aerial photographs were examined and the preliminary boundaries checked and modified, if necessary, to produce final land form and parent material boundaries. The photographs were contact prints at an approximate scale of 1:20,000. Date of photography was 1939.

The final land form and parent material boundaries were graphically reduced to produce the engineering soils map (1 inch = 1 mile). Symbols were used to delineate the parent materials as grouped according to land form and origin. Textural symbols were superimposed to indicate the relative compositions of the parent materials. The map also includes a set of soil profiles which indicate the general soil profiles of topographically high and low sites in the land form parent material areas.

Each profile shows the general range in depth and texture of each soil horizon— the A-, B-, and C-horizons--the latter being the parent material. The soil texture classification system used in the map profiles is that of the Indiana State Highway Commission (the ISHC soil classification system chart is shown on the map in the lower right hand corner). The ISHC systems differs slightly from the USDA system so that the use of USDA textures have to be converted to the ISHC textures - for example, a USDA classified loam could be a loam or clay loam under the ISHC system.

The soil profiles drawn on the left side of the engineering soils map have been numbered. Areas on the soils map have corresponding numbers to indicate the soil profile for that particular area in the field.

In the text of the report pedological soil names have been provided for each parent material soil area shown on the map. In Appendix B quantitative engineering soil test data is provided for each pedological soil name. In Appendix C qualitative data as to soil problems and certain advantageous soil uses are provided according to pedological soil names.

DESCRIPTION OF AREA

GENERAL

Boone County is located in central Indiana - see Figure 1. Lebanon, the county seat, is 25 miles northwest of Indianapolis.

County dimensions are about 18 miles in the north-south direction and about 24 miles east-west. The total area is 427 square miles.

> "Farming, mainly cash grain and livestock, is the main enterprise in the county. Corn, soybeans, and wheat are the main crops. Much of the county has poor natural drainage and needs extensive systems of artificial drainage.
>
> In the past few years, housing has been developing extensively in the rural areas of the county, especially around Zionsville and Lebanon. Industry in Lebanon and Indianapolis, in Marion County, provides employment for a large number of people who reside in Boone County." (3).

TABLE 1 (2): Some Significant Population Data for Boone County

Population Cities and Towns	Population 1970	Population 1960	Percent Change '60-'70
Advance	561	463	21.2
Jamestown	938	827	13.4
Lebanon	9,766	9,523	2.6
Thorntown	1,399	1,486	-5.9
Ulen	138	130	6.2
Whitestown	569	613	-7.2
Zionsville	1,857	1,822	1.9
Cities & Towns	15,228	14,864	2.4
Rural Areas	15,642	12,679	23.4
County Total	30,870	27,543	12.1

PROJECT	VOLUME ACRE FT	AREA ACRES
(1) SALEM DAM	798	74
(2) SCOTTSBURG RESERVOIR DAM	650	83
(3) LIBERTY RESERVOIR DAM		6
(4) LAKE LEMON	16,800	1,514
(5) SEYMOUR WATER COMPANY DAM (REPAIRS)		
(6) CEDARVILLE RESERVOIR DAM	1,550	1,200
(7) MUSCATATUCK-NORTH VERNON DAM	2,050	185
(8) MORSE RESERVOIR DAM	21,150	1,375
(9) MUNCIE WATER WORKS DAM		
(10) FERDINAND WATER WORKS DAM	112	10.5
(11) PAOLI WATER WORKS DAMS (4)	14	4
	9	3
	7	2
	7	3
(12) KOKOMO WATER WORKS OFF-CHANNEL RESERVOIR DAM	798	54
(13) CORYDON WATER WORKS DAM (REPAIR AND RAISING CREST)	9	
(14) BEAVER CREEK LAKE DAM, JASPER	2,770	205
(15) U. S. GYPSUM CO., OFF-CHANNEL RESERVOIR DAM	123	12.5
(16) GEORGETOWN RESERVOIR DAM	158	
(17) OSGOOD DAM	92	25
(18) TEMPORARY RESERVOIR FOR WESTPORT	20	
(19) GREENSBURG RESERVOIR DAM	48	11
(20) FRENCH LICK RESERVOIR DAM	53	.5
(21) LANESVILLE RESERVOIR DAM	129	13.5
(22) KOKOMO RESERVOIR DAM	5,370	520
(23) COAL PROCESSING RESERVOIR DAM, SULLIVAN COUNTY	525	150
(24) HOLLAND RESERVOIR DAM	178	23
(25) CORYDON RESERVOIR DAMS (2)	76	27
	118	38
(26) WASHING AND RECIRCULATING RESERVOIR, WARRICK COUNTY		60
(27) MUNCIE RESERVOIR DAM	22,000	1,275
(28) WESTPORT RESERVOIR DAM	52	
(29) BATESVILLE RESERVOIR DAM	2,100	200
(30) RICHMOND RESERVOIR DAM	3,095	173
(31) CHRISNEY LAKE DAM	101	20
TOTAL	78,939	7,283.5

NOTE
78,939 VOLUME ACRE FEET EQUAL
25.72 BILLION GALLONS OF STORAGE

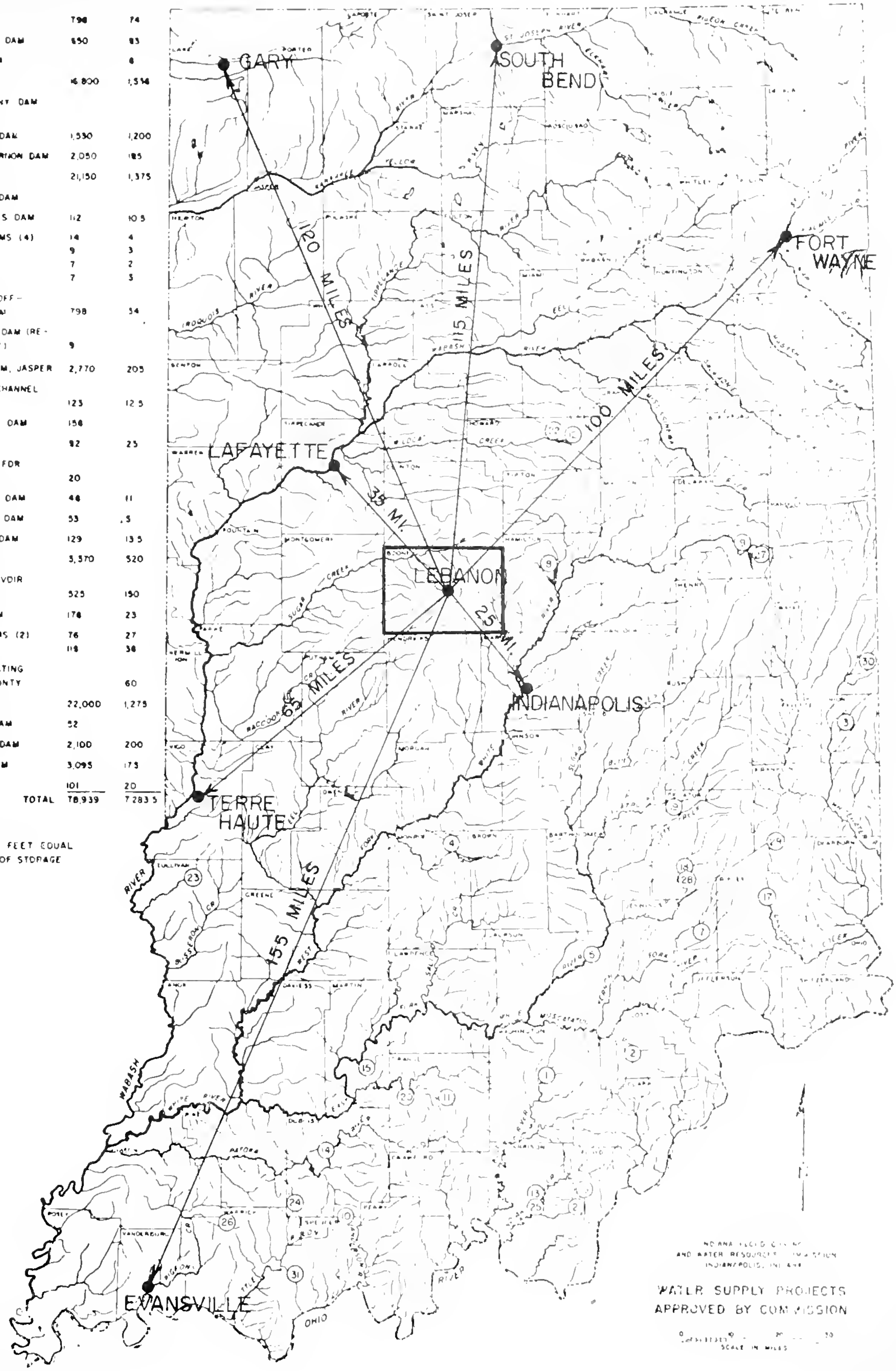


Fig. 1. Location of Boone County relative to: (1) other counties, (2) several cities (3) major streams and (4) water supply projects - 1961. (14)

DRAINAGE FEATURES

Drainage features of Boone County are shown in Figure 2, "Drainage Map - Boone County, Indiana", prepared by the Joint Highway Research Project, Purdue University, 1954 (13). Larger scale maps of one mile to the inch or two miles to the inch can be obtained by contacting JHRP, School of Civil Engineering. Both the large and small maps are two dollars a piece plus tax but no postage charge.

Interstate route I-65 and I-74 were contructed after the drainage map was printed and so they do not appear on the drainage map. Undoubtedly drainage for the interstate produced numerous changes in the immediate vicinity and, of course, these do not show on the map. There has also been considerable other road construction and ditching to produce drainage changes since 1954.

Boone County lies within two major drainage basins of the state - Wabash River and White River. Most of the northwestern half of the county lies in the Raccoon subdivision of the Wabash basin. The south central part is in the Eel subdivision. The southeastern part is the West Fork subdivision of the White River basin.

There are two major streams in the county. The largest, Sugar Creek, flows westerly across the northern third of the county. Its flood plain is over one-half mile in places and it has a gradient of five feet per mile. It has at least seven named tributary creeks in the county. Big Eagle Creek, flowing south, in the eastern part of the county, is the second largest stream. Most of its headwaters are in Boone County. Some of its

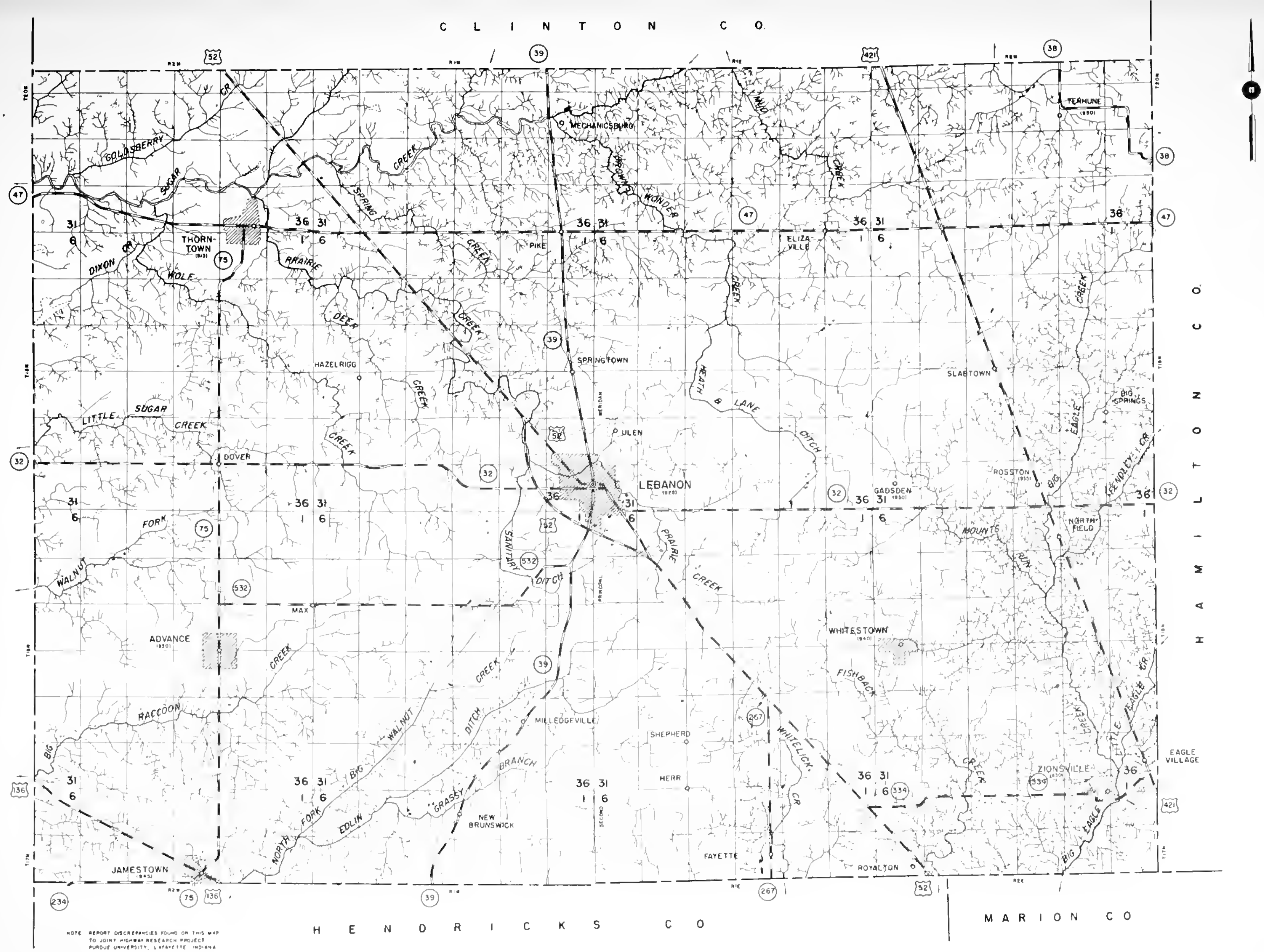


FIG. 2. DRAINAGE MAP OF BOONE COUNTY

flood plain, in the south, is over a quarter-mile wide and it has at least three named branching creeks in the county. Big Eagle Creek has a gradient of nine feet to the mile.

In the southwestern third of the county are several small creeks head-watering in the county and flowing generally westerly, southwesterly and southerly. North Fork Big Walnut Creek, now ditched, and Eldin Ditch flow in old glacial sluiceways.

In general, the county is relatively flat with a very young and poorly developed natural drainage system except within a mile or two of the larger creeks. Because of the clayey soil, a swale and swell topography, old glacial lake beds, high rainfall and extensive farming the county has installed numerous ditches and tile drains. There are also numerous farm ponds and small dams with man-made lakes. There are also many barrow pits and abandoned sand and gravel pits filled with water.

CLIMATOLOGICAL SUMMARY

Whitestown is an official weather station in Boone County. The following two pages contain a climatalogical summary of Boone County temperature and precipitation covering a 27-year (plus) period (1939-1966) prepared by the Whitestown station. Data was compiled by the U. S. Department of Commerce, Weather Bureau, in cooperation with the Whitestown Lions' Club (13).

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
IN COOPERATION WITH WHITESTOWN LION'S CLUB IN HONOR OF CLYDE O. LAUGHNER
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 — 12

LATITUDE 40° 00' N.
LONGITUDE 86° 20' W.
EV. (GROUND) 829 feet

CLIMATOLOGICAL SUMMARY

STATION WHITESTOWN, INDIANA

MEANS AND EXTREMES FOR PERIOD 1931-1960

	Temperature (°F)							**	Precipitation Totals (Inches)									Mean number of days					
	Means			Extremes								Snow, Sleet							Temperatures				
																			Max.		Min.		
Month	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year	Mean degree days	Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year	Precip. .10 inch or more	90° and above	32° and below	32° and below	0° and below	Month
(a)	30	30	30	30		30			30	30		30	30		30		30	30	30	30	30	
Jan.	37.3	20.2	28.8	70	1950	-21	1936	1120	2.83	2.54	1950	3.6	11.8	1956+	5.5	1956	5	0	10	27	3	Jan.
Feb.	39.8	21.8	30.8	70	1954	-18	1951	960	2.19	1.72	1959	3.0	8.7	1960	6.0	1939	5	0	7	25	2	Feb.
Mar.	49.0	28.7	38.9	82	1939	-12	1948	810	3.44	3.44	1938	3.7	10.1	1947	6.6	1951	7	0	3	21	*	Mar.
Apr.	62.5	39.5	51.0	87	1942	15	1940	420	3.54	3.09	1948	.5	3.6	1940	3.3	1940	7	0	*	8	0	Apr.
May.	73.5	49.6	61.6	99	1934	24	1947	170	4.42	4.06	1956	T	T	1960+	T	1960+	8	1	0	1	0	May
June	83.4	59.1	71.3	104	1934	36	1956	20	4.48	7.92	1957	0	0		0		7	7	0	0	0	June
July	87.5	62.3	74.9	112	1936	43	1947+	0	3.10	3.13	1955	0	0		0		5	11	0	0	0	July
Aug.	85.6	60.5	73.1	106	1936	39	1946	0	2.86	1.97	1947	0	0		0		5	9	0	0	0	Aug.
Sept.	78.3	53.1	65.7	105	1939	24	1942	110	3.05	3.72	1950	0	0		0		5	3	0	*	0	Sept.
Oct.	66.7	42.4	54.6	90	1939	18	1952+	320	2.79	3.05	1954	T	T	1959+	T	1959+	5	*	0	5	0	Oct.
Nov.	50.3	31.0	40.7	80	1933	- 6	1950	730	2.93	1.93	1948	2.4	10.7	1932	10.0	1932	6	0	2	18	*	Nov.
Dec.	39.3	22.8	31.1	67	1933	-16	1951	1050	2.47	2.00	1956	3.7	9.3	1934	5.5	1934	5	0	9	25	1	Dec.
Year	62.8	40.9	51.9	112	July 1936	-21	Jan. 1936	5710	38.10	7.92	June 1957	16.9	11.8	Jan. 1956+	10.0	Nov. 1932	70	31	31	130	6	Year

(a) Average length of record, years

T Trace, an amount too small to measure.

** Base 65°F and computed from monthly mean temperatures

\+ Also on earlier dates, months, or years.

* Less than one half

CLIMATE OF WHITESTOWN, INDIANA

Whitestown is located in central Indiana away from the moderating influence of oceans, but in the path of polar air outbreaks in the winter and the flow of tropical air from the Gulf of Mexico in the summer. The variety of weather from day to day and season to season results in an invigorating climate. This summary of Whitestown's climate would not be possible without the daily observations of Clyde O. Laughner beginning 50 years ago, October 1, 1910.

Centers of low air pressure frequently move across the central plains through Indiana to the St. Lawrence River Valley and the Atlantic Ocean. These storms which accompany most rains usually are preceded by southerly winds, declining air pressure and cloudiness, followed by lower temperatures, higher air pressure and sunny skies.

Precipitation is rather evenly distributed throughout the year, however, the months of May and June have a little more than other months, while December and February have the least. Spring and summer rains are usually sufficient for common crops, as the soil often has several inches of moisture in reserve as the result of spring precipitation.

Temperatures have ranged since 1909 from -24° to 112°F. July is the warmest month of the year when days with temperatures exceeding 90° average 11 in number. January is the coldest month. The winter season averages 7 days with temperatures below zero. An average day has a greater range of temperature in the summer than in the winter. The daily range of temperature is about 17° in the winter and 25° in the summer.

Snow has occurred as early as October and as late as May. The most snow comes in December and January. The greatest snowfall of any one day in the last 30 years was 10.0 inches recorded on November 16, 1932.

Relative humidity varies during a summer day from the 40's during a typical summer afternoon to 90 percent and higher just before dawn. Relative humidity rises and falls much as temperature does during a 24-hour period, but the highest percent usually occurs with the minimum temperature. Relative humidity is also lowered by the displacement of warm, moist tropical air with cold, dry Canadian air. In the winter, the most probable range of relative humidity from afternoon to night is from the 60's to the 90's. Fog is least apt to occur in the summer, but a winter month usually has 3 or 4 days of heavy fog.

Heating degree days indicate heating requirements for dwellings in the community. Fuel consumption for heating is proportional to degree day totals, so a month with twice the heating degree days of another month requires twice as much fuel for heating. Degree days for a single day are obtained by subtracting the mean temperature from 65°.

Frequency of brief heavy rainfall may be estimated from the climatology of the area. A rain of 1.3 inches in one hour occurs about once in 2 years; a rain of 2.1 inches in one hour occurs about once in 10 years; and a rain of 2.5 inches in one hour happens about once in 25 years. In a 6-hour period, 2 inches should be expected about every other year. The probability of 3.4 inches in 6 hours is 1 in 10 years and for 4.1 inches, about 1 in 25 years.

Thunderstorms occur on about 47 days of the year according to climatology of the area. This enumeration includes the occurrence of distant lightning and thunder. The average is about 8 a month in the late spring and early summer, and less than one a month in the winter. The thunderstorms are seldom so severe as to cause loss of life, property, or crops. Nine tornadoes occurred in Boone County during a 44-year period. Winds blow most frequently from the southwest; in the winter months the winds are most often northwesterly. Freezing rain or drizzle may be expected about 9 days per year according to a study of the period 1939 through 1948. Ice thickness exceeded ¼ inch on an average of once per year.

Lawrence A. Schaal
Weather Bureau State Climatologist
Purdue University, Agronomy Department
Lafayette, Indiana

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	30.4	36.0	34.2	50.3	57.0	72.8	78.0	72.9	70.2	56.6	48.5	38.0	53.8
1932	35.8	36.3	31.0	49.4	61.5	71.6	76.0	74.0	65.6	53.8	36.6	31.0	51.9
1933	37.4	30.0	39.2	50.9	64.4	78.0	77.8	72.8	71.8	53.0	39.6	35.2	54.2
1934	33.2	23.2	35.8	51.4	66.7	78.7	80.6	73.4	65.8	56.1	45.8	28.3	53.2
1935	30.4	32.9	47.2	48.8	57.0	67.8	77.6	75.2	66.2	54.4	41.2	24.8	52.0
1936	20.9	21.4	43.4	46.8	65.0	71.8	82.7	80.0	69.4	54.0	37.7	34.7	52.3
1937	31.8	29.8	36.0	49.8	62.5	70.3	74.2	76.0	63.6	51.2	37.2	27.2	50.8
1938	27.8	37.8	46.0	52.8	61.6	68.4	75.3	75.6	68.1	57.0	44.2	32.2	53.9
1939	33.2	30.6	42.1	47.9	65.0	73.3	74.8	72.9	71.9	56.0	40.3	34.4	54.6
1940	14.8	31.0	36.4	48.2	58.6	72.8	76.6	76.2	64.7	57.6	38.8	36.4	51.0
1941	29.8	26.9	35.2	56.4	65.0	71.8	75.8	73.6	68.9	57.6	42.1	36.3	53.3
1942	27.4	27.0	42.0	55.0	62.5	71.7	75.2	71.6	62.8	53.7	42.8	26.1	51.5
1943	28.1	31.6	36.4	48.8	62.1	74.8	75.2	74.4	61.6	52.5	38.2	28.8	51.0
1944	32.0	32.8	36.2	49.8	66.8	73.8	74.4	73.3	64.6	52.1	43.0	24.4	52.0
1945	22.6	32.0	50.8	52.4	56.6	67.8	71.8	71.0	66.2	51.0	41.9	23.1	50.6
1946	28.2	32.4	51.0	51.8	58.0	69.2	72.6	67.2	63.6	56.8	44.8	34.4	52.5
1947	31.4	22.0	32.0	49.6	56.6	66.6	68.9	77.1	64.9	59.3	36.0	29.8	49.5
1948	20.0	29.0	39.4	54.4	59.9	70.8	73.1	71.4	65.9	50.0	45.1	33.1	51.0
1949	31.1	30.3	39.9	48.2	61.7	73.5	78.9	73.7	62.8	59.0	40.6	33.9	52.8
1950	36.0	30.5	36.3	45.8	62.9	67.5	70.7	68.6	63.2	56.9	35.0	22.5	49.7
1951	29.8	29.7	37.8	47.6	62.6	67.7	71.7	69.6	62.2	56.2	34.5	29.4	49.9
1952	32.4	34.9	38.8	51.8	60.7	75.6	76.1	70.6	63.8	48.7	41.9	33.4	52.4
1953	32.3	35.1	41.7	47.6	63.5	74.2	74.0	72.1	64.5	56.4	42.0	32.0	53.0
1954	29.3	38.3	36.7	56.4	56.7	74.2	76.4	71.7	67.8	54.0	40.6	30.6	52.7
1955	26.3	30.5	40.0	56.5	62.8	65.6	77.9	74.2	66.7	54.0	37.3	27.0	51.5
1956	25.7	31.5	40.0	47.8	62.1	71.0	72.3	72.1	62.3	58.3	42.5	38.8	52.0
1957	22.8	35.3	39.8	52.3	61.4	70.4	72.8	71.5	63.6	49.5	40.9	35.2	51.3
1958	27.2	23.0	35.2	51.7	60.5	66.1	72.7	71.1	64.6	53.9	44.1	23.0	49.5
1959	24.0	30.8	39.0	51.8	65.8	71.5	73.1	75.9	67.6	53.5	36.2	35.4	52.1
1960	29.9	27.3	25.2	51.1	59.3	69.1	72.0	73.9	69.6	55.9			

Total Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1931	0.96	1.55	4.45	2.22	2.90	2.92	1.36	5.26	3.35	3.85	3.58	3.72	36.12
1932	4.82	1.73	1.88	2.30	0.56	5.13	3.02	2.68	6.39	3.79	3.03	5.40	40.73
1933	2.42	1.46	5.66	2.94	7.90	0.14	3.01	0.86	4.62	1.76	0.88	1.48	33.13
1934	1.72	0.80	3.88	2.38	0.38	1.75	4.27	2.73	4.48	0.31	2.75	1.89	27.34
1935	2.85	0.39	3.61	1.83	7.69	5.24	2.98	2.68	3.11	1.69	3.22	1.40	36.69
1936	1.40	2.89	2.80	2.76	2.17	1.10	0.16	2.95	5.66	4.24	2.84	3.37	32.34
1937	8.33	1.98	3.05	5.13	2.22	2.92	5.04	2.71	2.35	4.11	2.25	3.43	43.52
1938	0.93	3.07	8.97	3.26	4.47	6.06	6.90	2.60	1.87	1.02	3.36	1.56	44.07
1939	5.10	3.95	3.05	5.75	1.68	4.52	4.51	1.69	0.67	2.88	1.30	1.02	36.12
1940	1.66	1.72	2.18	4.29	3.73	1.68	0.48	2.46	0.42	2.16	3.90	2.69	27.37
1941	1.93	0.59	1.30	1.62	2.25	4.27	1.56	2.34	1.88	6.58	3.40	1.60	29.32
1942	1.33	4.16	3.22	2.77	4.86	5.84	3.71	2.70	2.26	1.67	4.50	1.73	38.75
1943	0.84	0.80	2.51	2.31	12.74	3.83	1.93	1.25	3.44	0.69	2.98	0.81	34.13
1944	0.11	3.26	4.57	6.56	4.02	3.99	0.57	2.06	1.69	0.97	2.45	1.22	31.47
1945	0.59	2.23	7.02	4.20	4.40	9.16	1.93	3.89	7.42	2.43	2.77	2.57	48.61
1946	1.32	2.80	3.74	1.98	9.92	4.27	2.05	4.04	0.76	2.89	3.09	3.02	39.88
1947	3.74	0.41	2.13	6.25	3.92	3.67	2.80	3.63	3.82	3.74	1.47	1.60	37.18
1948	2.12	2.80	6.27	6.05	3.78	4.62	1.27	0.94	3.08	3.25	4.65	3.41	42.24
1949	7.71	1.68	2.47	1.90	2.67	3.46	1.01	3.76	1.09	5.93	1.27	3.66	36.61
1950	11.49	4.26	3.14	2.67	1.86	5.68	4.60	2.46	7.38	1.16	4.94	2.38	52.02
1951	1.54	2.83	2.02	2.71	3.20	4.03	1.69	1.48	2.37	3.49	2.84	3.97	32.17
1952	2.97	2.32	4.85	4.19	4.43	5.77	1.97	4.38	5.04	0.91	3.31	2.04	42.18
1953	2.05	0.86	4.65	2.53	6.11	3.17	6.48	2.69	1.03	1.17	1.75	1.63	34.12
1954	2.65	2.44	3.41	4.26	2.71	1.73	2.07	4.07	0.51	6.33	1.29	2.17	33.64
1955	2.50	2.06	3.69	3.05	3.55	2.84	4.87	3.08	5.70	3.41	4.27	0.44	39.46
1956	1.31	3.20	2.19	3.13	11.13	6.04	2.67	2.33	1.35	1.68	2.55	4.78	42.36
1957	2.37	2.16	1.55	7.97	6.03	12.64	3.15	5.11	1.67	3.86	3.38	5.74	55.63
1958	1.25	0.59	1.45	1.86	4.61	10.85	7.99	4.64	2.95	2.09	4.02	0.28	42.58
1959	4.19	3.33	2.42	4.53	3.00	1.93	4.62	2.66	4.08	4.18	2.79	2.53	40.26
1960	2.58	3.26	1.19	2.66	3.81	5.26	4.18	1.73	1.11	1.31			

STATION HISTORY

Clyde O. Laughner in beginning his second half-century of observing and recording the weather at Whitestown is providing his fellowman with 50 years of basic climatological data seldom available anywhere in the country. A series of weather observations taken by one man in one location for over 50 years is a rarity. This enhances the quality of the recorded data since variation from changing locations and changing observers is avoided. The data is used in many more ways than any one man will ever know or comprehend. Every daily observation is now punched on a card. These have been processed to show the probability of rainfall for every week of the year based on the rainfall Mr. Laughner recorded. This information has numerous applications in industry and agriculture. A greater use in the future is a certainty.

The station was established January 1, 1909 and C. A. Stevenson was the observer until July 31, 1910. Mr. Laughner took over the climatological station October 1, 1910. Latitude, longitude and elevation has not changed since the establishment of the station.

EXTREMES AND DATE OF OCCURRENCE (1909-1960)

Month	Highest Temperature		Lowest Temperature		Greatest Daily Precipitation		Greatest Monthly Snowfall	
Jan.	70	1/25/50	-24	1/18/30	2.54	1/3/50	17.8	1918
Feb.	70	2/15/54	-18	2/2/51	1.72	2/10/59	24.5	1914
Mar.	84	3/24/10	-12	3/12/48	3.44	3/31/38	14.1	1912
Apr.	91	4/23/25	15	4/12/40	3.09	4/6/48	5.5	1910
May	99	5/31/34	24	5/9/47	4.06	5/27/56	2.1	1923
June	104	6/28/34	35	6/3/10	7.92	6/28/57		
July	112	7/14/36	43	7/22/47	3.13	7/15/55		
Aug.	106	8/22/36	39	8/30/46	3.57	8/6/26		
Sept.	105	9/15/39	26	9/26/28	3.72	9/1/50		
Oct.	90	10/8/39	15	10/29/25	3.60	10/26/20	2.0	1917
Nov.	80	11/1/33	- 6	11/25/50	1.93	11/5/48	10.7	1932
Dec.	67	12/15/33	-23	12/28/24	2.00	12/7/56	21.0	1930

DATES OF CRITICAL TEMPERATURES IN SPRING AND FALL (1921-60)

Minimum Temperature	Last in Spring: Earliest	Average	Latest	First in Fall: Earliest	Average	Latest
40 or lower	4/30/22	5/23	6/27/26	8/25/42	9/22	10/12/22
36 or lower	4/21/53	5/13	6/2/56	9/10/24	9/30	10/20/60
32 or lower	4/16/52	5/1	5/30/47	9/19/29	10/10	11/7/40
28 or lower	3/22/22	4/15	5/25/25	9/26/28	10/25	11/15/22
24 or lower	3/7/38	4/1	5/9/47	9/28/42	11/4	11/26/58
20 or lower	2/25/42	3/21	4/15/28	10/20/30	11/15	12/18/21
16 or lower	2/15/46	3/11	4/12/40	10/29/25	11/27	1/1/24

Use of the table: The average date of the last temperature of 40 or colder in the spring is May 23. The earliest date in all springs of the 1921-60 period was April 30 in 1922. The latest date was June 27 in 1926. In the fall, 40 or colder occurred as early as August 25 (1942) and as late as October 12 (1922).

GLACIAL GEOLOGY

Ice covered Boone County during at least three glacial ages, Kansan, Illinoian and Wisconsin. At present, only Wisconsin drift is exposed at the surface. At least two ice sheets moved across Boone in the Wisconsin age. The ice sheets were of the East White Sublobe of the Ontario-Erie Lobe. The first ice sheet reached the fartherest south, about 25 miles south of Boone County, about 21,000 years ago. This ice left a drift material called the Center Grove Till Member (Trafalgar Formation). (6)

The ice sheet then retreated and, about a 1000 years later, another ice sheet spread over Boone County again. It stopped in Hendricks County just south of Boone. The second till member, deposited in Boone County, is called the Cartersburg Till Member (Trafalgar Formation). (6)

Early geology maps show the Champaign Morainic System crossing Boone County, The mapping was done without the use of presently available high quality topographic maps and without the use of airphotos. In 1965, Wayne (6) wrote as follows: "During the past decade stratigraphic and physiographic studies in central Indiana have provided convincing evidence that the Champaign and Bloomington Moraines of Illinois cannot be traced east of the interlobate reentrant in western Indiana." Wayne further states that the readvancing East White Sublobe crossed and buried the Champaign and Bloomington Moraines and left few readily traceable moraines between the Wabash River, on the north, and the Wisconsin glacial boundary on the south. (6)

After a study of topographic maps and the aerial photographs, this author agrees with Wayne -- at least on the moraine situation in Boone County. Except for two very small areas (about one-fourth square mile each) in the southwestern corner of the county there is no other distinct ridge moraine in the county. There is, however, evidence of an ice marginal front. This is shown by large outwash areas along Sugar Creek and lacustrine plains southeast of Lebanon -- both land forms lie along a northwest southeast line.

The glacial drift materials in Boone County are primarily clayey, silty and sandy. There is a minimum of gravel and most of it is fine. Most of the outwash areas, namely outwash plains and valley trains in the western half of the county, are not sharply defined in the field or on the airphotos. It is felt that this is because the materials are mostly fine grained and/or are shallow deposits of materials. It is also felt that the areas would not be good sources for large supplies of construction aggregates and that the areas do not have good internal drainage.

The following information on the depth of bedrock is quoted from a thesis by Wilkerson (10). Fig. 3 is a reduced copy of Wilkerson's glacial drift thickness contour map (his Plate 4).

> "The thickness of unconsolidated deposits (depth to bedrock) in Boone County was mapped on a scale of 1 inch to 1 mile (see Plate 4). The map was compiled primarily from recent water-well logs from the Department of Natural Resources, Division of Water. The map contains about 250 control points consisting of actual depth to bedrock, as well as bedrock at greater depths. The placement of contour lines was aided by Brown (1949, Plate 3) Wayne (1956), and Burger et al., (1966). Contour lines are shown at 25, 50, 100, and 200 feet."

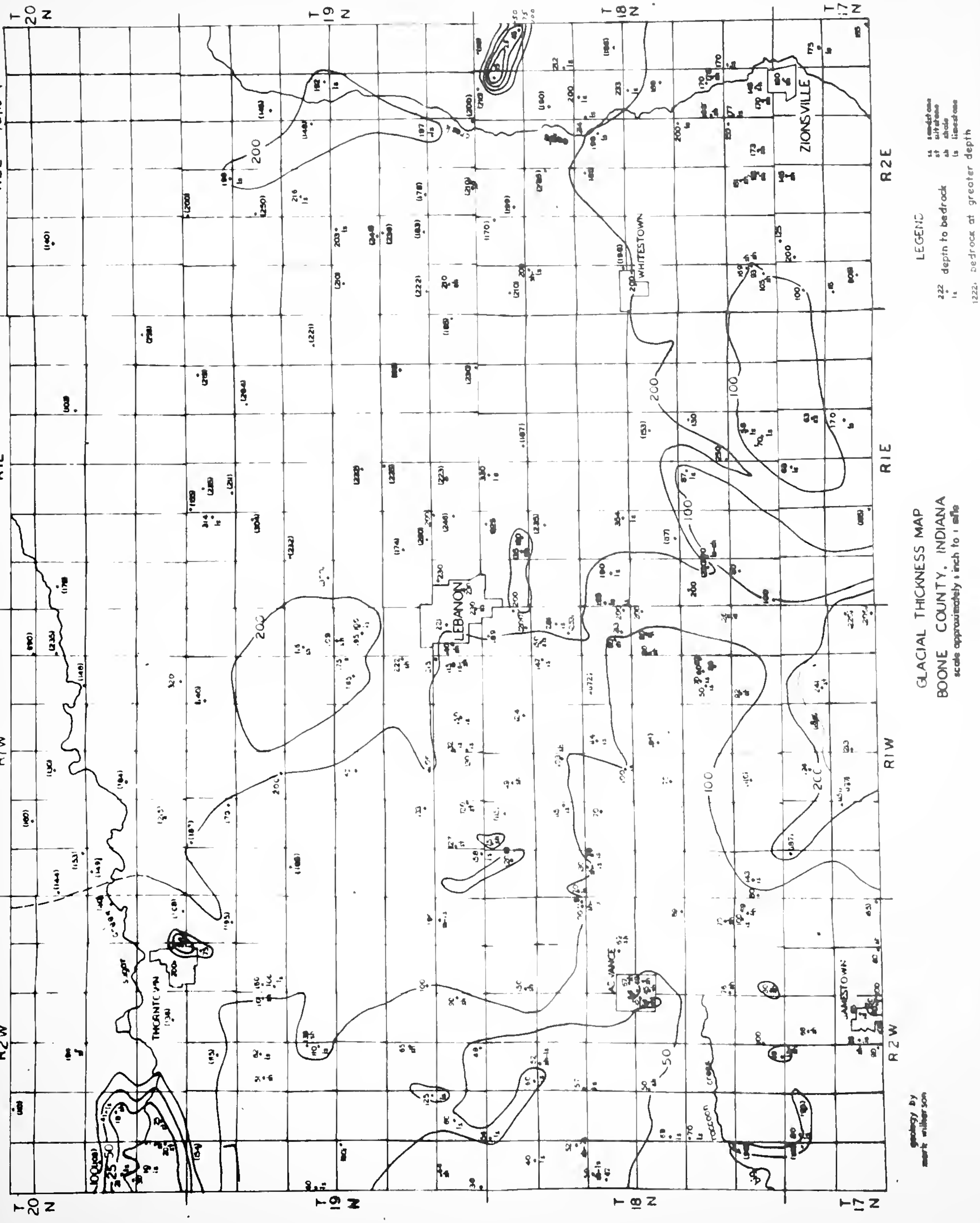


PLATE 4
GLACIAL THICKNESS MAP
BOONE COUNTY, INDIANA
scale approximately 1 inch to 1 mile
LEGEND
222 depth to bedrock
(222) bedrock at greater depth
ss sandstone
st siltstone
sh shale
ls limestone
LEBANON
WHITESTOWN
ZIONSVILLE
THORNTOWN
JAMESTOWN
R2E
R1E
R1W
R2W
T 20 N
T 19 N
T 18 N
T 17 N

FIG. 3

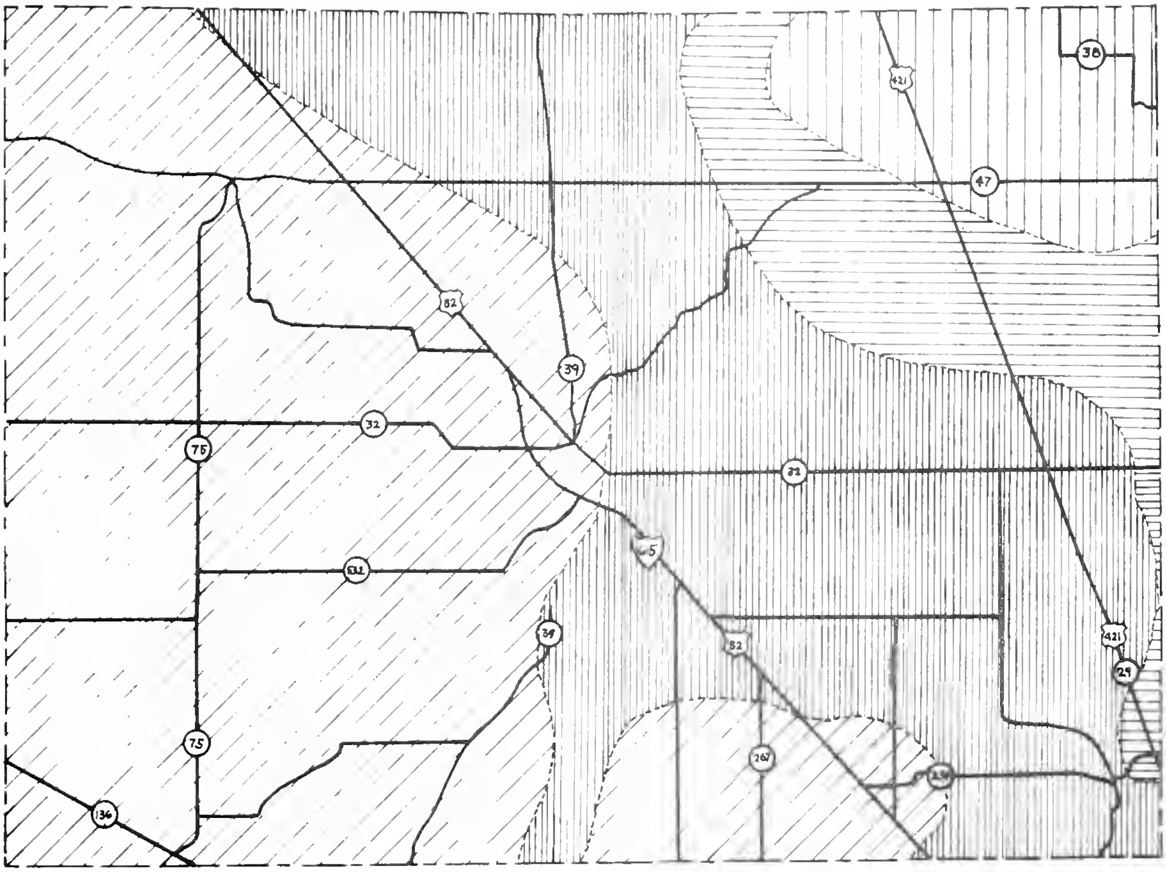
"The buried bedrock paleophysiographic provinces are the Scottsburg lowland to the northeast, and the Norman upland to the southwest, separated by the Knobstone escarpment represented approximately by the 200 foot contour line trending generally northwest through the center of the county."

"The thickness of glacial deposits are greater than 200 feet in most of the county. The greatest thickness of drift in Boone County is 354 feet, about three miles southeast of Lebanon. The second most common thickness are in regions underlain by 100-200 feet of drift, followed in decreasing order by 50-100, 25-50, and 0-25 feet. It is probable that approximately 500-1000 acres of the county are underlain by less than 25 feet of drift. The occurrence of this "bedrock high" is probably due to the resistant nature of the rock." (10) Note that rock comes to within 15 feet of the surface on the counties east-central border.

BEDROCK GEOLOGY

Figure 4 shows a generalized bedrock geology map of Boone County. (8,9) Regional dip of the bedrock is a few degrees west-southwest -- therefore younger rocks are in the west and older ones in the eastern part of the county.

Bedrock is exposed at the surface three miles west of Thorntown and rock reportedly comes within 15 feet of the surface on the east-central county boundary. The exposed rock, near Thorntown, is a calcareous, thinly bedded, jointed siltstone and is not good for commercial aggregate. The near-surface rock in the eastern part of the county is of unknown type and quality to the writer. Presently there are no bedrock quarries in the county and there is a definite shortage of medium and coarse gravel.



MISSISSIPPIAN — LOWERMOST PART OF HARRODSBURG LIMESTONE
BORDEN GROUP, AND ROCKFORD LIMESTONE
SILTSTONE, SHALE, SANDSTONE, AND SOME LIMESTONE

DEVONIAN AND MISSISSIPPIAN — NEW ALBANY SHALE
MOSTLY BLACK SHALE

DEVONIAN — ROCKS OF MIDDLE DEVONIAN AGE
MOSTLY LIMESTONE, AND DOLOMITE

SILURIAN — NIAGARAN SERIES
LIMESTONE, DOLOMITE, AND CALCAREOUS SILTSTONE.
LC, BASE OF LISTON CREEK LIMESTONE MEMBER; W
BASE OF WALDRON

FIG. 4. BEDROCK GEOLOGY OF BOONE CO.

Below is additional information from Wilkerson's thesis (6) on the bedrock exposure at Thorntown.

> "There is only one region in the county where bedrock is exposed at the surface. The rock outcrops in a short tributary entering Sugar Creek about three miles west of Thorntown in section 32. The tributary is in a small topographic basin (about one acre) whose floor rests on the bedrock. The basin is probably an old gravel pit whereby operations were stopped when the bedrock was encountered. The maximum exposed thickness of rock is about 6 feet. The rock is also exposed along the southern banks of Sugar Creek, east of the entering tributary for some 1500 feet, and 100 feet east of the county line thickening into Montgomery County." (10)
>
> "The rock is a calcareous, thinly bedded, jointed, siltstone. Preliminary tests by the Indiana Geological Survey, indicate a 36 percent carbonate content. The rock presents a problem in that the physical characteristics fit the upper Borden Group (Edwardsville formation) while the stratigraphic position should be in the lower Borden (New Providence shale). It could represent a drastic facies change of the New Providence shale or a part of a large tongue of upper Borden material which extends into the Illinois Basin. Paleontological, chemical, and physical studies are currently being conducted by the Indiana Geological Survey to help determine the stratigraphic position in the Borden Group." (10)

PHYSIOGRAPHY AND TOPOGRAPHY

Boone County lies in the Central Lowlands province of the United States and in the Till Plains section of the province. In Indiana, the till plains area is known as the Tipton Till Plains.

The lowest elevations are in the northwest corner of the county. Here Sugar Creek enters the county from Clinton County, at about 870 feet elevation, and leaves at the Montgomery line at about 780 feet -- a drop of 90 feet in 17 miles. Maximum local relief around Sugar Creek is about 50-60 feet within a mile of the creek.

On the east side of the county headwaters of Eagle Creek drain plains around 950 feet elevation and the stream enters Marion County at about 805 feet -- a drop of 145 feet in 16 miles. Maximum local relief around Eagle Creek is around 100 feet, within one-half mile,in the southeastern corner of the county.

Glacial sluiceways running southwesterly from south of Lebanon drain plains around Lebanon at an elevation of about 950 feet. The sluiceways meet near the southern border and leave the county at elevation 910. The sluiceways are depressed only several feet below the till plain surface.

Raccoon Creek drains the till plains at about 940 elevation and leaves the southeastern corner of the county at elevation 880.

The county is generally a massive till plain draining toward all corners except the northeast corner. The till plain is gently undulating with relief of swells and swales mostly in the five to ten foot range and a much lesser amount ranging between ten and twenty feet.

Eagle Creek has the widest flood plain -- slightly over one-half mile in places. West of I-65 the creek has some well developed terraces, over one-half mile wide, and some adjacent poorly developed outwash plains about a mile wide. Most of the several tributary creeks entering Eagle Creek have narrow flood plains and only two have any terrace development. Eagle Creek, for its large size, also has very little terrace development.

On the western side of the county are several poorly defined outwash areas. The outwash materials are evidently thin and relatively high in fines. Soil scientists, walking the area, have detected soil material changes but others can find little or no land form development or expression of outwash materials. Poor expression has caused some accademic discussion on the choice of land form name. Outwash plain, valley train and lacustrine plain names have been used for the indistinct outwash areas in the west.

South of Lebanon are several flat areas each ranging up to one or two square miles that appear to be old glacial lake beds. When meltwaters were high, they flowed over a present drainage divide and down the two southwesterly trending sluiceways. The sluiceways are now separated from the lacustrine plains, to the southeast of Lebanon, by a small natural drainage divide. The lacustrine plain areas have been drained by a fairly extensive and deep-ditch drainage system.

There are some very small kames and muck pockets widely scattered over the county -- they lend little significant topographic expression to the county.

ENGINEERING SOIL AREAS

The soils of Boone County can be divided into three major groups: (I) glacial or ice-contact soil deposits, (II), fluvial or water-deposited soils, and (III) muck deposits. In the discussion that follows, each of the major groups is further subdivided into land form parent material groups. These groups are further subdivided into soil textural groups for which pedological names are also provided. Using the pedological names and Appendices A, B and C, engineering properties and problems for all soil areas can be obtained.

I. GLACIAL DEPOSITED MATERIALS

The land forms of glacial, or ice-contact deposits in Boone County include ground moraines, ridge moraines, eskers and kames.

(1) Ground Moraine - Silty Clay Texture

The largest area of land form parent material in the county is a till plain area (see the map in the pocket of this report). This till plain of Wisconsin ground moraine covers about two-thirds of the county to the east, north and south of Lebanon. Another large area of ground moraine (till plain) is in the west-central part of the county but it is covered with 20 in. to 40 in. of windblown silt and is discussed separately below.

On the attached engineering soils map, in the left margin, general soil profiles for topographic highs and lows in the area have been drawn and designated profile set No. 1. The bounded areas

on the map, containing No. 1, have high and low position soil profiles similar to those sketched in Profile Set No. 1.

The parent material (C-horizon material) is most often a loam or a clay loam (ISHC classification) and most often is found at a depth of 24 in. to 50 in.--as indicated by profile set NO. 1. Top of the B-horizon is usually found between a depth of 6 in. and 18 in. and may be either a loam, clay loam, clay or silty clay. B-horizons in the topographic lows are generally more clayey and thicker than B-horizons in the higher positions. A-horizon material is either a silt loam, silty clay loam, silty clay or clay and thickness ranges from about 6 in. to 18 in.

Quantitative engineering soils data and data on engineering soil problems and uses in the particular ground moraine area are provided in Appendices B and C. To obtain information on soils in high topographic positions look up the information provided for the Miami soils, for low positions — Brookston soils, and in between positions — Crosby soils.

In the southwestern corner of the county, on each side of I-74, are two small areas (less than one-quarter square mile) of ridge moraine. The parent material is similar to the ground moraine discussed above.

(2) <u>Ground Moraine, Loess Covered - Silty Clay Texture</u>

A large triangular-shaped area covering the west central part of the county contains ground moraine covered with about 20 in. to

40 in. of loess (windblown silt). The area in the soils map is designated with four loess symbol markings (like + signs) per square mile. The area is also designated by the No. 2 on the map which also is the numberof the soil profile set for the area.

A field inspection of the area shows the silty surface soils are not pure silts but rather silt loams, silty clay loams (highs), and silty clays and clays (lows) — all with at least traces of sand and gravel. This is because clay and fine sand particles are also transported with the silt and because frost action has forced up sand and gravel particles, from the underlying till, through the predominantly windblown silty material. These surface soils (A-horizon) have a depth range of 6 in. to 20 in.

Generally the B-horizon shows two layers that grade into each other. The upper part of the B-horizon is usually silty clay or clay in both high and low positions. The lower part of the B-horizon in the upper position is usually clay and the lower part of the low position is either silt loam or silty clay loam. The bottom of the B-horizon ranges between depths of 24 in. and 70 in.

For engineering soils data on topographic highs in the area look in Appendices B and C under Fincastle soils. For data on lows--use data on Ragsdale soils.

(3) Kames

In general, kames in Boone County are relatively small both in area and height. Most of them shown on the engineering soil maps are so low, and so small in area, that they were hardly discernable

on the airphotos. Several have been completely mined out and some others have been nearly exhausted. Others are so small that they would supply aggregate (mostly sand) for only very minor local operations.

The largest "kame-area" is just south of Thorntown. It is not a typical conical kame deposit relative to land form, and geologist call it an ice-contact deposit, but it is mapped herein as a kame simply because it appears to be a very large mound of granular material. Some of the largest kames are within the city limits of Lebanon and to the northeast of Lebanon. A few are at the south central border of the county. The many small ones are widely scattered across the county.

Kames and kame areas are encircled by dashed lines on the soils map. They have the soil profile of the high of Profile Set No. 5. Parent material is mostly sand with some gravel. Engineering soils data is found in Appendices B and C under the Fox or Ockley soils.

II FLUVIAL DEPOSITED MATERIALS

The fluvial or water deposited materials in Boone County include: (1) alluvium or recent flood plain deposits along streams, (2) stream terrace deposits, (3) valley train deposits--deposits along streams lacking typical water-cut terrace land forms, (4) glacial sluiceways deposits--relatively long and narrow valley train deposits, (5) outwash plain deposits and (6) lacustrine plain (lake bed) deposits.

(4) Alluvial Plains--Stratified Silts, Fine Sand and Clays Texture

The two largest alluvial plain areas (bounded by sawteeth on the map) are along the two largest streams—Sugar Creek, in the northwest, and Eagle Creek in the southeast. The tributaries to these streams also have small alluvial plains. Some small alluvial plains are found along small creeks in the southwestern corner of the county. Annual flooding should be anticipated within the sawtooth areas.

Parent material, at a depth of 30 in. to 60 in., is usually stratified loams and sandy loams or loams and clay loams. B-horizon materials may be silt loam, silty clay loam, clay loams or loam. Top of the B-horizon is between 7 in. and 20 in. A-horizon materials are usually silt loams or clay loams.

Engineering data is the alluvial soils are found in Appendices B and C. For information on topographic highs in the flood plain, look under Genessee soil, and for low level soils—see Shoal soils. For data on soils in depression in the low level areas—see Sloan soils.

(5) Terraces, Outwash Plains, Valley Trains, and Glacial Sluiceways--Stratified, Gravelly Sand Texture

The above mentioned land forms are all composed of a common granular outwash parent material. The terraces are mainly stream cut benches adjacent to the larger stream flood plains. Outwash plains are generally on the uplands. In Boone County, most are found in the west-central part of the county. The valley trains are the granular outwash deposits found in valleys, usually along streams, but without the relatively flat, stream-cut-shape

of terraces. The glacial sluiceways are essentially similar to valley trains but are more narrow or elongated.They also have less outwash material than the valley trains.

The granular outwash parent material is about two-thirds clean sand (considerable is fine sand) and about one-third gravel. The gravel is mostly pea gravel and other fine gravel sizes - lesser amount of medium and coarse size gravels. Two 20-ft. sections made by Wilkerson on Sugar Creek show strata thickness ranging from about 6 in. to 3 ft. There are strata of: fine sand, medium sand and coarse sand, gravelly sand, pea gravel and cobbly gravel. The stratified sands and gravels are generally found between depths of 30 in. and 60 in.

The B-horizons usually are gravelly clays at the bottom overlain by mainly clays and clay loams. Depth to the top of the B-horizon is 5 in. to 18 in. The A-horizons may be either silt loams, sily clay loam, silty clay or clay.

In the west central part of the county, where there is a 20 in. to 40 in. loess cover, the topographic highs are Ockley soils. Where the loess cover is lacking, the high soils are Fox. In the low areas of the loess areas, the low soils are Sleeth and in the lows of nonloess areas,the soils are Westland. See Appendices B and C, for engineering properties of these soils.

Wilkerson (6) did some sampling and testing of four sand and gravel pits in Boone. Two of the pits were in river terrace land forms and two were in kame areas. Locations are as follows:

1. Sugar Creek, Midstate Aggregate Co. NW1/4 Sec 29 T20N R1E
2. Eagle Creek, SW1/4 NW1/4 SE1/4 Sec 3 T18N R2E

3. Kame, SW1/4 SE1/4 Sec 10 T19N R2W

4. Kame, SE1/4 NE1/4 Sec 12 T17N R2W

The following is a summary of Wilkerson's test results. The results of each test are shown in Tables 4 through 9. "In summary, all four samples generally meet Indiana State Highway Standard Specifications for coarse aggregates for class A aggregate. Sand to gravel ratios of the four samples are: 72/28, 58/42, 67/33, 60/40, respectively. Each sample contains a somewhat higher percentage of sand than is desirable. None of the samples exceeded the limits of deleterious substances specified by the Indiana State Highway Standard Specifications (see Table 8). The chert content appears slightly high in Sample 1 but no means for separation by specific gravity were employed."

"The percent loss of material from the Los Angeles abrasion test ranged from 30-39%, all below the 40% maximum loss required by the state of Indiana. These relatively low losses are due to the sound nature of the predominately limestone aggregate."

"The percent loss of material from the Iowa Freeze-Thaw test is above the 6 percent maximum allowable loss, according to Iowa specifications, for all four samples. Since Indiana has no specifications for the freeze-thaw test, it is difficult to predict the response of the aggregate in concrete and asphalt uses. However, the 8 to 13 percent loss in the four samples may indicate a somewhat lesser durability than is desired for aggregate used by the highway and construction industries in Indiana."

The following sieve analysis and petrographic analysis of

the Sugar Creek sample is fairly representative of the granular outwash material at all four sites.

Size	Wt (gm)	%Retained
1 1/2 in.	0	0.00
1	1468	3.66
3/4	1118	2.79
3/8	3490	8.72
No. 4	5124	12.80
8	5335	13.32
16	5919	14.78
30	5713	14.26
50	7870	19.65
100	3720	9.29
200	198	0.49
Pan	90	0.22
	40.045	99.98

Rock Type	% by Wt.
Dolomitic limestone	73.90
Carbonate (soft weath)	2.07
Chert (dense)	4.64
Chert (porous)	1.05
Sandstone (hard)	0.05
Sandstone (friable)	0.09
Clay lumps	0.01
Shale (org + silty)	0.05
Granite	4.54
Andesite/Diorite	8.29
Basalt/Gabbro	0.05
Quartzite	1.20
Gneiss (sl weath)	0.07
Gneiss (mod weath)	0.05
Gneiss (deep weath)	0.01

(6) <u>Lacustrine Plains, Valley Trains, Terraces, Outwash Plains, and Glacial Sluiceways--Stratified Silts, Silty Sands and Clay Textures</u>

The materials of the land forms listed above were deposited in either quite waters (lake beds) or in slow running waters. The soils are mostly stratified silts, silty sands, and clays.

The larger lacustrine plains are located immediately southeast and south of Lebanon. Another large one is located due south of Lebanon near the county line. Smaller ones are located northeast of Lebanon. The southern one, near the county line, has the most sharply defined borders. The following is quoted from "Soil Survey of Boone County, Indiana".

> "A large level area of Mahalasville soils lies halfway between New Brunswick and Fayette. This area was at one time a glacial lake. Stratified sand, which was the

lake bottom, occurs at a depth of 3-7 ft. Finer textured silt and clay were blown and washed into the water and settled over the sand. Eventually the lake filled and became a swamp until man cleared and drained it". (3)

Most of the other lacustrine plain areas in the county do not show the distinct airphoto pattern of a lacustrine plain. The borders are not sharp and the surface is not distinctly level or flat. It is possible that they were shallow lakes with slow running water going through them coming from the edge of a weak ice-marginal front. It is conceivable that some might call them a combination lacustrine plain -outwash plain and others may say outwash plain.

The large lacustrine-plain-mapped areas, immediately southeast of Lebanon, originally overflowed into two well-developed sluiceways flowing southwesterly, Presently, the large lacustrine plain areas and sluiceways are separated by a low natural drainage divide. All the lacustrine plain areas are thoroughly ditched and drain generally northward. The old glacial sluiceways are also ditched and drain southwesterly. Field inspection of some significant ditches, both in the lacustrine plain and sluiceway areas, showed a predominance of clayey soil material. The predominance of clays was another reason for calling the large areas southeast of Lebanon, lacustrine plains.

On the engineering soils map all the following land form areas containing profile number No. 5 including lacustrine plains, glacial sluiceways, valley trains, outwash plains and terraces, have a parent material of stratified fine-grained soils and lesser

amounts of sand. Airphoto patterns of all the above mentioned land forms are also poorly defined. This may be because of the high content of fines and/or the shallowness of the materials. Some large outwash plains north and south of Sugar Creek and valley trains in the western half of the county, show some characteristics of water deposition but have very little or essentially no infiltration basins. These areas contain some pits--most likely many excavations for granular materials or borrow, but most of the pits are extremely small and widely scattered.

Pedologically, the main soil type of all these fluviatile land forms in the very poorly drained Mahalasville silty clay loam in the topographic lows. The C-horizon soils are stratified loams, sandy loams, sands, clay loams, silty clays and clays. By the Unified Soil Classification system the majority of soils are stratified clayey sands and lean clays. The parent material soils are at a depth of 36 in. to 60 in.

The lower part of the B-horizon is composed of loams, and clay loams, and the upper part of silty clays and clays. The top of the B-horizon ranges between 10 in. and 18 in. The A-horizon is also silty clay or clay.

Engineering properties and uses of soils in the lows of all the above mentioned land form areas can be found in Appendices B and C under Mahalasville soils.

In the topographic high areas of these various fluviatile deposits (soil profile No. 5 areas on the engineering soils map), pedological data indicates the parent materials soils are more sandy. The highs are Whitiker soils whose C-horizon is stratified

sands, sandy loams, loams, silt loams, silty clay loams, and clay loams (SM and SC by the Unified system). Depth to parent material is between 36 in. and 60.

B-horizon material usually has three layers—the bottom may be sand or sandy loam, the next layer may be sandy loam sandy clay loam or sandy clay, and the top layer—clay. The top of the B-horizon is a depth of 8 in. to 16 in. The A-horizon is usually silt loam or silty clay loam.

Engineering data for the highs is given in Appendices B and C under Whitiker soils.

III MUCK AND HIGHLY ORGANIC TOP SOIL DEPOSITS

The recent soil survey does not show any organic soils series in Boone County. Most likely there are no peat or marl deposits in the county of any significance. However, airphotos indicate numerous, widely scattered, small, dark gray to black basins or relatively low topographic areas—an indication of highly organic top soil areas. The areas probably are highly organic top soil areas or muck areas and have a slightly deeper depth of organic soils than the swale areas of the till plains.

BIBLIOGRAPHY

1. Brown, E. A., "Ground Water Resources of Boone County, Indiana", Bulletin No. 4, Indiana Department of Conservation, Division of Water Resources, 1949.

2. Hittle, J. E., "Population Trends for Indiana Counties, Cities and Towns 1960-1970", Highway Extension and Research Project for Indiana Counties, Purdue University.

3. Langlois, K. H. Jr., "Soil Survey of Boone County, Indiana, Soil Conservation Service, U. S. Department of Agriculture in Cooperation with Purdue University Agricultural Experiment Station, February 1975.

4. Taylor, E. A., "The Roads and Road Materials of Portions of Central and Eastern Indiana", (Delaware County - page 555), 30th Annual Report, Indiana Department of Geology and Natural Resources, 1905.

5. Testing Service Corporation, "Soil Survey Report for Projects No. I-65-5(22)140 P. E., I-65-5(35)140 Constr. Boone County, Section 1-South Half and Section 2-North Half" Wheaton, Illinois, 1965.

6. Wayne, W. J., "Ice and Land - A Review of the Tertiary and Pleistocene History of Indiana", reprint from "Natural Features of Indiana", Indiana Academy of Science, State Library, Indianapolis, Indiana, 1966.

7. Wayne, W. J., "The Crawfordsville and Knightstown Moraines in Indiana", Indiana Department of Conservation Geological Survey Report of Progress 28, Bloomington, Indiana, 1965.

8. Wayne, W. J., "Thickness of Drift and Bedrock Physiography of Indiana North of the Wisconsin Glacial Boundary", Indiana Department of Conservation, Geological Survey Report of Progress 7, 1956.

9. Wayne, W. J., Johnson, G. H., Keller, S. J., "Geologic Map of the 1° x 2° Danville Quadrangle, Indiana and Illinois, Showing Bedrock and Unconsolidated Deposits", Department of Natural Resources, 1966.

10. Weir, C. E., and Gray, H. G., "Geologic Map of the 1° x 2° Indianapolis Quadrangle, Indiana and Illinois, Showing Bedrock and Unconsolidated Deposits", Department of Natural Resources, 1961.

11. Wilkerson, Mark, "Applications of Geology to Land Use Planning in Boone County, Indiana", Masters Thesis, Purdue University, West Lafayette, Indiana, 1975.

12. Yeh, P. T., "Drainage Map of Boone County," Joint Highway Research Project, Purdue University, 1954.

13. "Climatological Summary", U. S. Department of Commerce Environmental Science Administration in Cooperation with Whitestown Lions Club Climatography of the United States No. 20-12, Station - Whitestown, Indiana, 1960.

14. Progress Report, Indiana Flood Control and Water Resources Commission, December 1961.

SOIL SURVEY

TABLE .—*Engineering*

[Tests performed by Soils and Pavement Design Laboratory, Joint Highway Research Project, School of Civil Engineering, Purdue of State Highway

Soil name and location of sample	Parent material	Report No.	Depth	Moisture-density data [1]		Mechanical analysis [2]		
				Maximum dry density	Optimum moisture	Percentage passing sieve— 1 in.	¾ in.	⅜ in.
			In.	*Lb./cu. ft.*	*Pct.*			
Fincastle silt loam: SE¼NW¼ sec. 2, T. 19 N., R. 2 W. (Modal).	Loess over glacial till of Wisconsin age.	5-1	0-8	104	19	--------	--------	100
		5-6	26-41	98	22	--------	--------	--------
		5-8	60-72	132	8	100	96	93
Miami silt loam: NE¼SE¼ sec. 13, T. 19 N., R. 2 W. (Coarse textured).	Glacial till of Wisconsin age.	7-1	0-8	108	17	100	96	96
		7-2	8-20	108	17	100	99	97
		7-5	46-55	127	10	--------	100	96
Ockley silt loam: SE¼NE¼ sec. 34, T. 20 N., R. 2 W. (Modal).	Loamy outwash over sand and gravel.	6-1	0-8	98	22	--------	--------	100
		6-5	21-28	104	19	100	99	91
		6-10	55-72	119	12	100	96	88
Ragsdale silty clay loam: SE¼NW¼ sec. 27, T. 19 N., R. 1 W. (Modal).	Silty material.	4-1	0-8	94	25	--------	--------	--------
		4-4	21-32	97	23	--------	--------	--------
		4-6	43-53	126	21	--------	100	97
Whitaker silt loam: SW¼NW¼ sec. 10, T. 18 N., R. 1 E. (Coarse-textured substratum).	Loamy outwash over stratified silt and sand.	8-1	0-9	105	18	--------	--------	100
		8-5	23-32	129	14	--------	--------	100
		8-8	51-60	114	14	--------	--------	100

[1] Based on AASHO Designation T 99-57, Method A (*1*).

[2] Mechanical analyses according to AASHO Designation T 88-57 (*1*). Results obtained by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming the textural class of a soil.

APPENDIX B (3)

TABLE .—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The different tions for referring to other series. The sign>

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Ft.	*In.*			
Brookston:					
Br	[1] 0-1	0-18	Silt loam	ML or CL	A-4 or A-6
		18-50	Clay loam	CL	A-6
		50-60	Loam	ML or CL	A-4
Bs	[1] 0-1	0-28	Silty clay loam	OL or CL	A-7
		28-39	Clay loam	CL	A-6
		39-60	Loam	ML or CL	A-4
*Crosby: CrA, CsB2. For Miami part of CsB2, see Miami series, unit MmB2.	1-3	0-7	Silt loam	ML or CL	A-4 or A-6
		7-29	Clay loam	CL or CH	A-7
		29-60	Loam	CL or SC	A-4
Fincastle: FcA	1-3	0-13	Silt loam	ML or CL	A-4 or A-6
		13-31	Silty clay loam	CH	A-7
		31-43	Clay loam	CL or CH	A-6 or A-7
		43-60	Loam	CL or SC	A-4

See footnotes at end of table.

test data

University, West Lafayette, Indiana, in accordance with standard methods of testing of the American Association Officials (AASHO) (*1*)]

Mechanical analysis [2] —Continued								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued				Percentage [3] smaller than—						AASHO [4]	Unified [5]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	Pct.			
99	98	90	75	68	50	22	13	29	9	A-4(8)	CL
100	99	97	83	80	65	39	25	58	38	A-7-6(20)	CH
88	82	70	39	33	24	14	9	20	8	A-4(1)	SC
94	93	92	80	68	50	25	18	33	11	A-6(9)	CL
96	94	89	65	54	43	28	20	39	21	A-6(11)	CL
90	84	74	37	28	18	12	8	17	2	A-4(1)	SM
99	99	95	82	77	57	24	16	32	9	A-4(8)	ML-CL
87	82	74	45	42	35	25	18	59	36	A-7-6(9)	SC
76	59	29	11	8	5	3	2	[6] NP	NP	A-1-b(0)	SW-SM
	100	98	95	92	72	33	19	55	24	A-7-5-(17)	CH
		100	99	94	74	40	31	64	41	A-7-6(20)	CH
96	95	95	91	75	47	19	15	30	9	A-4(8)	CL
99	98	92	65	60	43	19	14	26	8	A-4(6)	CL
99	97	89	38	33	25	20	18	31	13	A-6(2)	SC
99	97	74	14	11	8	5	3	NP	NP	A-2-4(0)	SM

[3] Clay percentage was determined by the hydrometer method and varies several percent from field determinations.
[4] Based on AASHO Designation M 145-49 (*1*).
[5] Based on MIL-STD-619B (*8*).
[6] Nonplastic.

significant to engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc- means more than; the sign < means less than]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Frost-heave potential	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	*In/hr.*	*In./in of soil*	*pH*		
90-100	90-100	75-85	0. 63-2. 00	0. 17-0. 20	5. 5-6. 5	Moderate to high	Low.
95-100	85-95	70-90	0. 06-0. 20	0. 19-0. 21	6. 0-7. 3	Moderate	Moderate.
90-100	75-90	60-75	0. 20-0. 63	0. 17-0. 20	(2)	Moderate	Low.
100	90-100	85-95	0. 20-0. 63	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
95-100	85-95	70-90	0. 06-0. 20	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
90-100	75-90	60-75	0. 20-0. 63	0. 17-0. 20	(2)	Moderate	Low.
95-100	90-100	75-90	0. 63-2. 00	0. 17-0. 20	6. 5-7. 3	Moderate to high	Low.
95-100	85-95	65-85	0. 06-0. 20	0. 19-0. 21	5. 5-7. 3	Moderate	Moderate.
85-95	70-85	35-65	0. 06-0. 20	0. 17-0. 20	(2)	Moderate	Low.
95-100	90-100	75-95	0. 63-2. 00	0. 17-0. 20	5. 5-6. 5	Moderate to high	Low.
95-100	90-100	85-100	0. 06-0. 20	0. 19-0. 21	5. 5-6. 5	Moderate	Moderate.
95-100	85-100	65-85	0. 06-0. 20	0. 19-0. 21	6. 5-7. 3	Moderate	Moderate.
80-95	70-90	35-70	0. 06-0. 20	0. 17-0. 20	(2)	Moderate	Low.

TABLE —*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Ft.	*in.*			
Fox: FsA, FsB2, FsC2	>6	0–8	Silt loam	ML or CL	A-4 or A-6
		8–18	Silty clay loam	CL	A-7
		18–38	Clay loam or gravelly clay loam.	SC or CL	A-6
		38–60	Sand and gravel	SW-SM	A-1
Genessee: Gn	>6	0–25	Silt loam	ML	A-4
		25–60	Loam	CL or SC	A-6
Hennepin: HeF	>6	0–14	Loam	CL or SC	A-4
		14–60	Loam	CL or SC	A-4
Mahalasville: Ma	[1] 0–1	0–34	Silty clay loam	OL or CL	A-7
		34–41	Loam	CL or SC	A-4
		41–60	Silty clay loam and loamy sand	CL or SC	A-2 or A-4
Miami:					
MmA, MmB2, MmC2, MmD2, MmE2	>6	0–8	Silt loam	ML or CL	A-4 or A-6
		8–26	Clay loam	CL or CH	A-6 or A-7
		26–60	Loam	CL or SC or SM	A-4
MsB3, MsC3, MsD3	>6	0–24	Clay loam	CL or CH	A-6 or A-7
		24–60	Loam	CL or SC or SM	A-4
Ockley: OcA, OcB2	>6	0–14	Silt loam	ML or CL	A-4 or A-6
		14–39	Silty clay loam, gravelly clay loam, and clay loam.	CL or SC	A-6 or A-7
		39–55	Loamy sand and sandy loam	SM or ML	A-4
		55–72	Sand and gravel	SW-SM	A-1
Ragsdale: Ra	[1] 0–1	0–32	Silty clay loam	OH or CH	A-7
		32–60	Silt loam	ML or CL	A-4
Reesville: Re	1–3	0–11	Silt loam	ML or CL	A-4 or A-6
		11–29	Silty clay loam	CH	A-7
		29–60	Silt loam	ML or CL	A-4
Shoals: Sh	1–3	0–36	Silt loam	ML	A-4
		36–60	Loam	CL or SC	A-6
Sleeth: St	1–3	0–13	Silt loam	ML or CL	A-4 or A-6
		13–24	Clay loam	CL	A-6
		24–48	Gravelly clay loam	SC or CL	A-6
		48–60	Sand and gravel	SW-SM	A-1
Sloan: Sx	[1] 0–1	0–8	Silt loam	ML or CL	A-4
		8–33	Clay loam	CL	A-6
		33–60	Loam	CL	A-4
Westland: We	[1] 0–1	0–8	Silty clay loam	OL or CL	A-7
		8–45	Clay loam	CL or CH	A-7
		45–53	Gravelly clay loam	SC or CL	A-6
		53–60	Sand and gravel	SW-SM	A-1
Whitaker: Wh	1–3	0–9	Silt loam	ML or CL	A-4 or A-6
		9–27	Clay loam	CL	A-6
		27–46	Sandy clay loam, loamy sand, and sandy loam.	SC or SM	A-2 or A-4
		46–60	Stratified sand, sandy loam, loam, and silt loam.	SC or SM	A-2 or A-4

[1] Ponded.
[2] Calcareous.

significant to engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Frost-heave potential	Shrink-swell potential
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
			In/hr.	*In./in. of soil*	*pH*		
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
95–100	90–100	85–95	0. 63–2. 00	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
90–100	75–90	35–70	0. 63–2. 00	0. 17–0. 20	5. 5–6. 3	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
90–100	75–100	75–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
85–95	70–85	45–65	0. 63–2. 00	0. 17–0. 20	6. 5–7. 8	Moderate	Low.
85–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
100	90–100	85–95	0. 06. 0. 20	0. 19–0. 21	6. 0–7. 3	Moderate	Moderate.
90–100	70–85	45–65	0. 20–0. 63	0. 17–0. 20	7. 3–7. 8	Moderate	Low.
95–100	90–100	30–70	0. 63–2. 00	0. 17–0. 20	(2)	Moderate to high	Low.
90–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	5. 5–6. 0	Moderate to high	Low.
90–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 0–6. 0	Moderate	Moderate.
80–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
90–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 0–6. 0	Moderate	Moderate.
80–95	70–85	35–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	5. 5–7. 3	Moderate to high	Low.
80–100	65–90	40–75	0. 63–2. 00	0. 19–0. 21	5. 0–6. 5	Moderate	Moderate.
90–100	70–80	45–55	2. 00–6. 30	0. 12–0. 17	5. 5–7. 3	Moderate	Low.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
100	95–100	95–100	0. 06–0. 20	0. 19–0. 21	6. 0–7. 3	Moderate to high	Moderate.
95–100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	(2)	High	Low.
100	90–100	85–95	0. 63–2. 00	0. 17–0. 20	5. 5–6. 0	Moderate to high	Low.
100	95–100	90–100	0. 06–0. 20	0. 19–0. 21	5. 5–6. 5	Moderate to high	Moderate.
95–100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	(2)	High	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
90–100	75–100	45–65	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate	Low.
95–100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 0–7. 3	Moderate to high	Low.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 5–6. 5	Moderate	Moderate.
90–100	75–90	35–70	0. 63–2. 00	0. 19–0. 21	6. 0–7. 8	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
100	90–100	75–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low to moderate.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	6. 5–7. 8	Moderate	Moderate.
90–100	75–100	45–65	0. 63–2. 00	0. 17–0. 20	(2)	Moderate	Low.
100	90–100	85–95	0. 20–0. 63	0. 17–0. 20	6. 5–7. 3	Moderate	Moderate.
95–100	85–95	65–85	0. 06–0. 20	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
90–100	75–90	35–70	0. 06–0. 20	0. 19–0. 21	6. 5–7. 3	Moderate	Moderate.
50–70	20–45	5–15	>20. 0	<0. 08	(2)	Low	Low.
95–100	90–100	65–90	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate to high	Low.
95–100	85–95	65–85	0. 63–2. 00	0. 19–0. 21	5. 5–6. 5	Moderate	Moderate.
90–100	70–90	10–50	0. 63–2. 00	0. 17–0. 20	6. 5–7. 3	Moderate	Low.
95–100	70–90	10–50	0. 63–2. 00	0. 12–0. 20	(2)	Moderate to high	Low.

TABLE —*Interpretations of engineering*

[An asterisk in first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The different tions for referring

Soil series and map symbols	Suitability of soils as a source of—			Soil features affecting		
	Topsoil	Sand and gravel	Road subgrade material	Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Brookston: Br	Good in surface layer. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Bs	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
*Crosby: CrA, CsB2. For Miami part of CsB2 see Miami series, unit MmB2.	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Fincastle: FcA	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc-
to other series]

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poor drainage; seasonal high water table; subject to ponding.	Severe: very poor drainage; seasonal high water table; subject to ponding.
In subsoil and substratum, fair to poor stability, fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poor drainage; seasonal high water table; subject to ponding.	Severe: very poor drainage; seasonal high water table; subject to ponding.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches.

TABLE —*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Fox: FsA, FsB2, FsC2.	Fair to good in surface layer. Poor to fair in subsoil: moderately fine to coarse texture.	Good: About 36 inches of overburden on well-graded mixture of sand and gravel.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; low susceptibility to frost heave; fair to to poor stability.	Loose sand and gravel can be easy to excavate but sometimes hinders hauling; cuts and fills often needed in places; difficult to vegetate exposed gravel in road cuts; subsoil is subject to frost heave.	Natural drainage is adequate; not needed.	Rapid seepage rate in substratum.
Genessee: Gn	Good in surface layer. Good to fair in subsoil: subject to stream flooding.	Poor to unsuitable: location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Subject to flooding and frost heave.	Natural drainage is adequate; subject to flooding; not needed.	Moderate to slow seepage rate; subject to flooding.
Hennepin: HeF	Fair in surface layer: thin; steep slopes. Fair to poor in subsoil.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Cuts and fills needed; difficult to vegetate road cuts; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
Mahalasville: Ma	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture: seasonal high water table.	Not suitable	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; poor compaction; medium compressibility; low shrink-swell potential; subject to frost heave; poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability; stratified silt and sand below depth of 36 inches.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Difficult to vegetate; erosion hazard during construction.	Good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Slight where slopes are 0 to 6 percent; possible contamination of ground water. Moderate where slopes are 6 to 12 percent; downslope seepage; possible contamination of ground water.	Severe: porous sand and gravel at depth of 30 to 40 inches; very rapid permeability in sand and gravel.	Severe: porous sand and gravel at depth of 30 to 40 inches; hazard of free-leachate flow to ground water.
In subsoil and substratum, fair stability; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Subject to flooding; fair to poor shear strength; low shrink-swell potential; medium to high compressibility.	Severe: subject to flooding; moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding.
In subsoil and substratum, fair stability; fair to poor shear strength; fair to poor compaction characteristics, moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential.	Difficult to vegetate; erosion hazard during construction.	Fair to poor shear strength; low shrink-swell potential; medium to high compressibility.	Severe: steep and very steep slopes; downslope seepage.	Severe: steep and very steep slopes severely hinder development of site.	Severe: steep and very steep slopes severely hinder development of site.
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, poor stability and compaction; moderate permeability when compacted; medium compressibility; poor resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: slow permeability; seasonal high water table.	Severe: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding.

TABLE —*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Miami: MmA, MmB2, MmC2, MmD2, MmE2.	Fair to good in surface layer. Fair to poor in subsoil: moderately fine texture.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability.	Cuts and fills needed; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
MsB3, MsC3, MsD3	Fair to poor in surface layer and subsoil: moderately fine texture.	Not suitable	Fair to poor in subsoil and substratum; fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate to low shrink-swell potential; subject to frost heave; fair to poor stability.	Cuts and fills needed; subject to frost heave.	Natural drainage is adequate; not needed.	Moderate to slow seepage rate.
Ockley: OcA, OcB2	Good in surface layer. Fair in subsoil moderately fine to coarse texture.	Good: at least 42 inches of overburden over well-graded mixture of sand and gravel.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; low frost heave; fair to poor stability.	Loose sand and gravel easy to excavate but hinders hauling at times; cuts and fills needed in places; difficult to vegetate exposed gravel in road cuts; subsoil subject to frost heave.	Natural drainage is adequate; not needed.	Rapid seepage rate in substratum.
Ragsdale: Ra	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil and substratum: fair to poor shear strength; fair compaction characteristics; medium compressibility; moderate to low shrink-swell potential; subject to frost heave; fair stability; seasonal high water table.	Seasonal high water table; moderately high susceptibility to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Moderate where slopes are 0 to 12 percent; moderate permeability. Severe where slopes are 12 to 25 percent; moderate permeability; downslope seepage.	Moderate where slopes are 0 to 6 percent; moderate permeability. Severe where slopes are 6 to 25 percent; slope severely hinders development of site.	Slight where slopes are 0 to 12 percent; moderate where slopes are 12 to 25 percent; slope moderately hinders development of site.
In subsoil and substratum, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Moderate where slopes are 2 to 12 percent; moderate permeability; downslope seepage. Severe where slopes are 12 to 18 percent; moderate permeability; downslope seepage.	Moderate where slopes are 2 to 6 percent; moderate permeability. Severe where slopes are 6 to 18 percent; slope severely hinders development of site.	Slight where slopes are 2 to 12 percent; moderate where slopes are 12 to 18 percent; slope moderately hinders development of site.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable.	Good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Slight: moderate permeability; possible contamination of ground water.	Severe: porous sand and gravel at depth of 42 to 60 inches; very rapid permeability in sand and gravel.	Severe: porous sand and gravel at depth of 42 to 60 inches; hazard of free leachate flow to ground water.
In subsoil and substratum, fair stability; fair compaction characteristics; moderate to low permeability when compacted; medium compressibility; fair resistance to piping; moderate to low shrink-swell potential; fair to poor shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding; fair to poor shear strength; moderate to low shrink-swell potential; medium compressibility; moderate to high susceptibility to frost heave.	Severe: slow permeability; seasonal high water table.	Severe: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table; subject to ponding; silty clay loam and silt loam materials hinder trafficability.

TABLE —*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of— Topsoil	Sand and gravel	Road subgrade material	Soil features affecting— Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Reesville: Re	Good in surface layer. Fair to poor in subsoil; moderately fine texture; seasonal high water table.	Not suitable	Fair to poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; high compressibility; moderate shrink-swell potential; subject to frost heave; fair to poor stability; seasonal high water table. Poor to fair in substratum: fair to poor shear strength; poor to fair compaction characteristics; medium compressibility; low shrink-swell potential; subject to frost heave; poor to fair stability.	Seasonal high water table; moderate to high susceptibility to frost heave.	Seasonal high water table; slow permeability.	Moderate to slow seepage rate; seasonal high water table.
Shoals: Sh	Good in surface layer. Good to fair in subsoil; subject to stream flooding; seasonal high water table.	Poor to unsuitable: location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Fair to poor in subsoil and substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability; seasonal high water table.	Subject to flooding and frost heave; seasonal high water table.	Seasonal high water table; moderate permeability; subject to flooding.	Moderate to slow seepage rate; subject to flooding; seasonal high water table.
Sleeth: St	Good in surface layer. Fair in subsoil: moderately fine to coarse texture; seasonal high water table.	Good: at least 42 inches of overburden on well-graded mixture of sand and gravel; dipper equipment necessary.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; fair to poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; moderate permeability; sand and gravel in substratum.	Rapid seepage rate in substratum; seasonal high water table.
Sloan: Sx	Good in surface layer. Good to fair in subsoil: subject to stream flooding; seasonal high water table.	Poor to unsuitable; location of sand and gravel spotty; deep overburden; dipper equipment necessary.	Poor in subsoil: fair shear strength; good to fair compaction characteristics; medium compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; low shrink-swell potential; subject to frost heave; fair stability.	Subject to flooding and frost heave; seasonal high water table.	Seasonal high water table; moderate permeability; subject to flooding.	Moderate to slow seepage rate; subject to flooding; seasonal high water table.

See footnote at end of table.

properties of the soils—Continued

Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair to poor stability; fair to poor compaction characteristics; low permeability when compacted; high compressibility; fair to good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, poor to fair stability; poor to fair compaction characteristics; moderate permeability when compacted; medium compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility; moderate to high susceptibility to frost heave.	Severe: slow permeability; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table; use limited to periods when the water table is at a depth of more than 48 inches; silt loam and silty clay loam materials hinder trafficability.
In subsoil and substratum, fair stability; fair to poor shear strength; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential.	Soil features favorable; generally not needed.	Seasonal high water table; subject to flooding, fair to poor shear strength; low shrink-swell potential; medium to high compressiblity.	Severe: seasonal high water table; subject to flooding; moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding; somewhat poorly drained; seasonal high water table.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable.	Seasonal high water table; good to fair shear strength; moderate to low shrink-swell potential; medium compressibility in subsoil; slight compressibility in substratum.	Severe: moderate permeability; seasonal high water table.	Severe: porous sand and gravel at depth of 40 to 60 inches; very rapid permeability in sand and gravel.	Severe: somewhat poorly drained; seasonal high water table; sand and gravel at depth of 40 to 60 inches; hazard of free leachate flow to ground water.
In subsoil, fair stability; good to fair compaction characteristics; low permeability when compacted; medium compressibility; good resistance to piping; moderate shrink-swell potential; fair shear strength. In substratum, fair stability; fair to poor compaction characteristics; moderate to low permeability when compacted; medium to high compressibility; fair resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable: generally not needed.	Seasonal high water table; subject to flooding; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility; subject to ponding.	Severe: seasonal high water table; subject to flooding; moderate permeability.	Severe: subject to flooding.	Severe: subject to flooding; very poorly drained; seasonal high water table.

TABLE .—*Interpretations of engineering*

Soil series and map symbols	Suitability of soils as a source of—			Soil features affecting		
	Topsoil	Sand and gravel	Road subgrade material	Highway location	Drainage for crops and pasture	Farm ponds: Reservoir area
Westland: We	Fair to good in surface layer: moderately fine texture. Poor in subsoil: moderately fine texture; seasonal high water table.	Good: at least 42 inches of overburden on well-graded mixture of sand and gravel; dipper equipment necessary.	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Very good in substratum: good to fair shear strength; fair to good compaction characteristics; slight compressibility; low shrink-swell potential; fair to poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; slow permeability; sand and gravel substratum.	Rapid seepage in substratum; seasonal high water table.
Whitaker: Wh	Good in surface layer. Fair to poor in subsoil: moderately fine texture; seasonal high water table.	Not suitable	Poor in subsoil: fair to poor shear strength; fair to poor compaction characteristics; medium to high compressibility; moderate shrink-swell potential; subject to frost heave; fair stability; seasonal high water table. Fair to poor in substratum: fair to poor shear strength; poor compaction characteristics; medium compressibility; low shrink-swell potential; subject to frost heave, poor stability.	Seasonal high water table; subject to frost heave.	Seasonal high water table; moderate permeability; stratified silt and sand below depth of 36 inches.	Moderate seepage rate; seasonal high water table.

[1] *Slight* means that the soil is relatively free of limitations or that the limitations are easily overcome; *moderate* means that overcoming

USDA texture.—The United States Department of Agriculture textural classification is based on the relative amounts of sand, silt, and clay particles in a soil (*6*).

Unified and AASHO classifications.—These are explained under the heading "Engineering classification systems."

Percentage passing sieves 10, 40, and 200.—The values in these columns are estimates rounded off to the nearest 5 percent. Gravel-size material does not pass the No. 10 sieve. The material that passes the No. 200 sieve is mainly silt and clay, but the smaller grains of very fine sand also pass it.

Permeability.—This term refers to the downward movement of water through undisturbed soil material. Estimates are based mostly on texture, structure, and consistence.

Available water capacity.—This term refers to the capacity of a soil to hold water in a form available to plants and to the amount of water held in the soil that is wet to field capacity. The available water capacity is the measurement of the difference between the amount of water held in the soil at field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Reaction.—This column lists estimated ranges in field pH values for each major horizon.

Frost-heave potential.—Frost action includes heave caused by ice lenses forming in a soil and the subsequent loss of strength as a result of excess moisture during periods of thawing. Three conditions must exist for frost heave to become a major consideration: (1) a susceptible soil, (2) a source of water during the freezing period, and (3) freezing temperatures that persist long enough to penetrate the ground.

Shrink-swell potential.—This is the quality of the soil that determines its volume change in proportion to its moisture content. The shrink-swell potential of a soil is estimated primarily on the basis of the amount and kind of clay in a soil.

properties of the soils—Continued

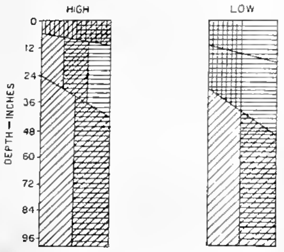
Soil features affecting—Continued			Soil limitations [1] for—		
Farm ponds—Continued: Embankments, dikes and levees	Grassed waterways	Foundations of buildings	Sewage disposal fields	Sewage lagoons	Sanitary landfills
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, fair to poor stability; fair to good compaction characteristics; high to moderate permeability when compacted; slight compressibility; fair to good resistance to piping; low shrink-swell potential; good to fair shear strength.	Soil features favorable; generally not needed.	Seasonal high water table; subject to ponding. In subsoil, fair to poor shear strength; medium to high compressibility; moderate shrink-swell potential. In substratum, good to fair shear strength; slight compressibility; low shrink-swell potential.	Severe: slow permeability; seasonal high water table.	Severe: porous sand and gravel at depth of 40 to 60 inches; very rapid permeability in sand and gravel.	Severe: very poorly drained; seasonal high water table; subject to ponding; porous sand and gravel at depth of 40 to 60 inches; hazard of free leachate flow to ground water.
In subsoil, fair stability; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; good resistance to piping; moderate shrink-swell potential; fair to poor shear strength. In substratum, poor stability; poor compaction characteristics; moderate permeability when compacted; medium compressibility; poor resistance to piping; low shrink-swell potential; fair to poor shear strength.	Soil features favorable.	Seasonal high water table; fair to poor shear strength; moderate to low shrink-swell potential; medium to high compressibility.	Severe: moderate permeability; seasonal high water table.	Severe: stratified material at depth of less than 60 inches allows rapid seepage at times.	Severe: somewhat poorly drained; seasonal high water table; stratified loamy and sandy material at depth of less than 60 inches; hazard of free leachate flow to ground water.

the limitations is generally feasible; and *severe* means that the use of the soil for this purpose is questionable.

GENERAL SOIL PROFILES

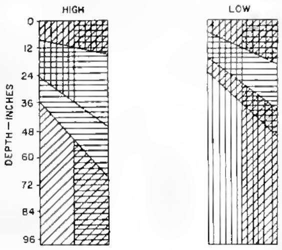
GROUND MORAINE

SILTY CLAY TEXURE
(PROFILE SET NO. 1)



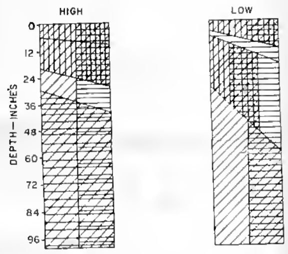
GROUND MORAINE – LOESS COVER

SILTY CLAY TEXTURE
(20 40 IN. WIND BLOWN SILT COVER
(PROFILE SET NO. 2)



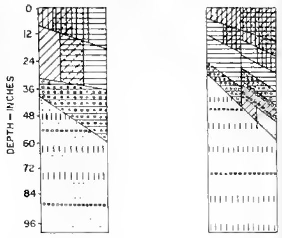
ALLUVIAL PLAINS

STRATIFIED SILTS, FINESANDS, AND CLAYS TEXTURE
(PROFILE SET NO. 3)



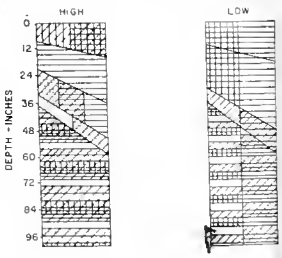
TERRACES, OUTWASH PLAINS GLACIAL SLUICEWAYS AND KAMES

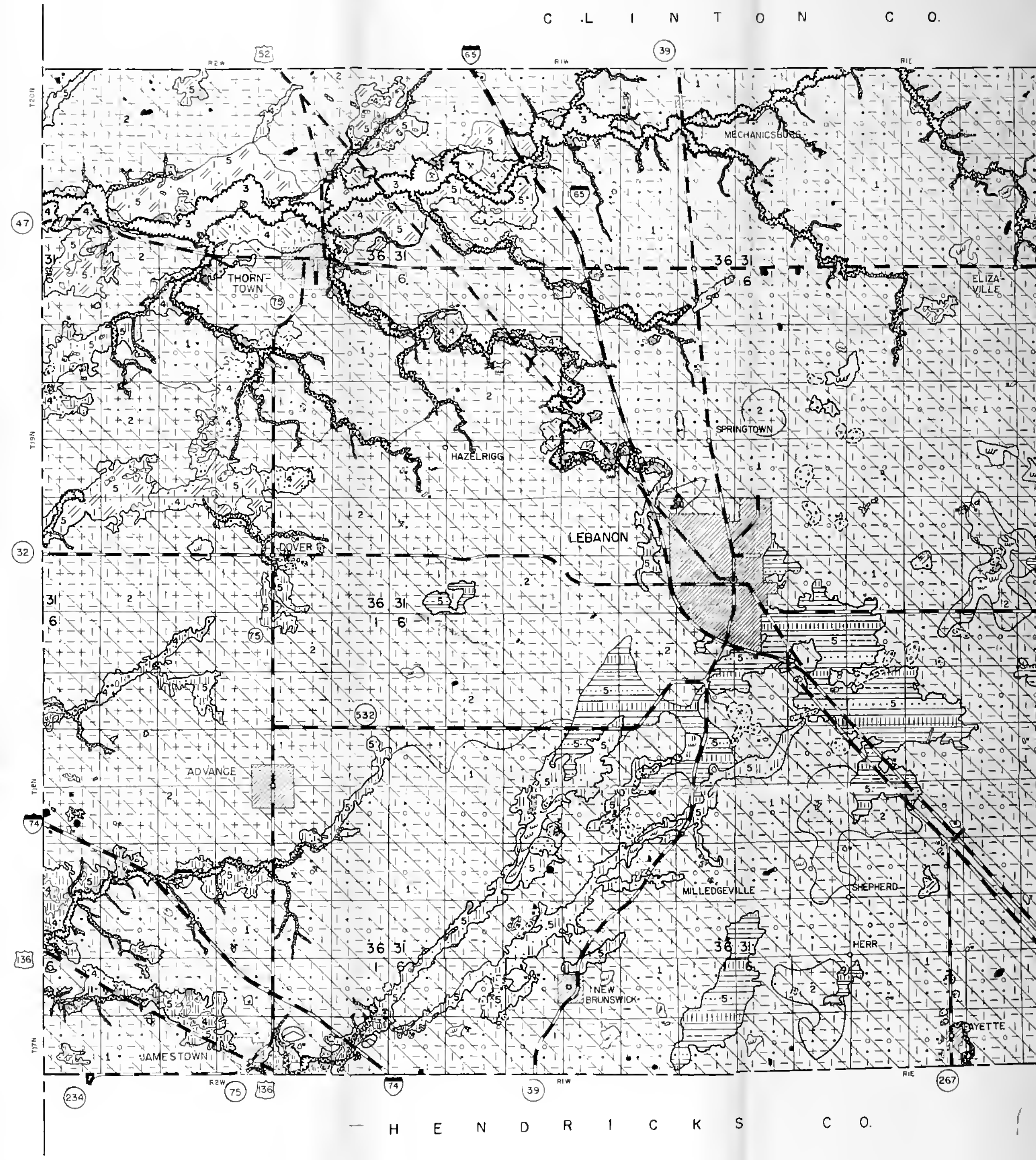
STRATIFIED SILTY SANDS WITH SOME GRAVEL
(PROFILE SET NO 4)



LACUSTRINE PLAINS, VALLEY TRAINS, TERRACES OUTWASH PLAINS AND GLACIAL SLUICEWAYS

STATIFIED SILTS, SILTY SANDS AND CLAYS
(PROFILE SET NO 5)





ENGINEERING SOILS MAP

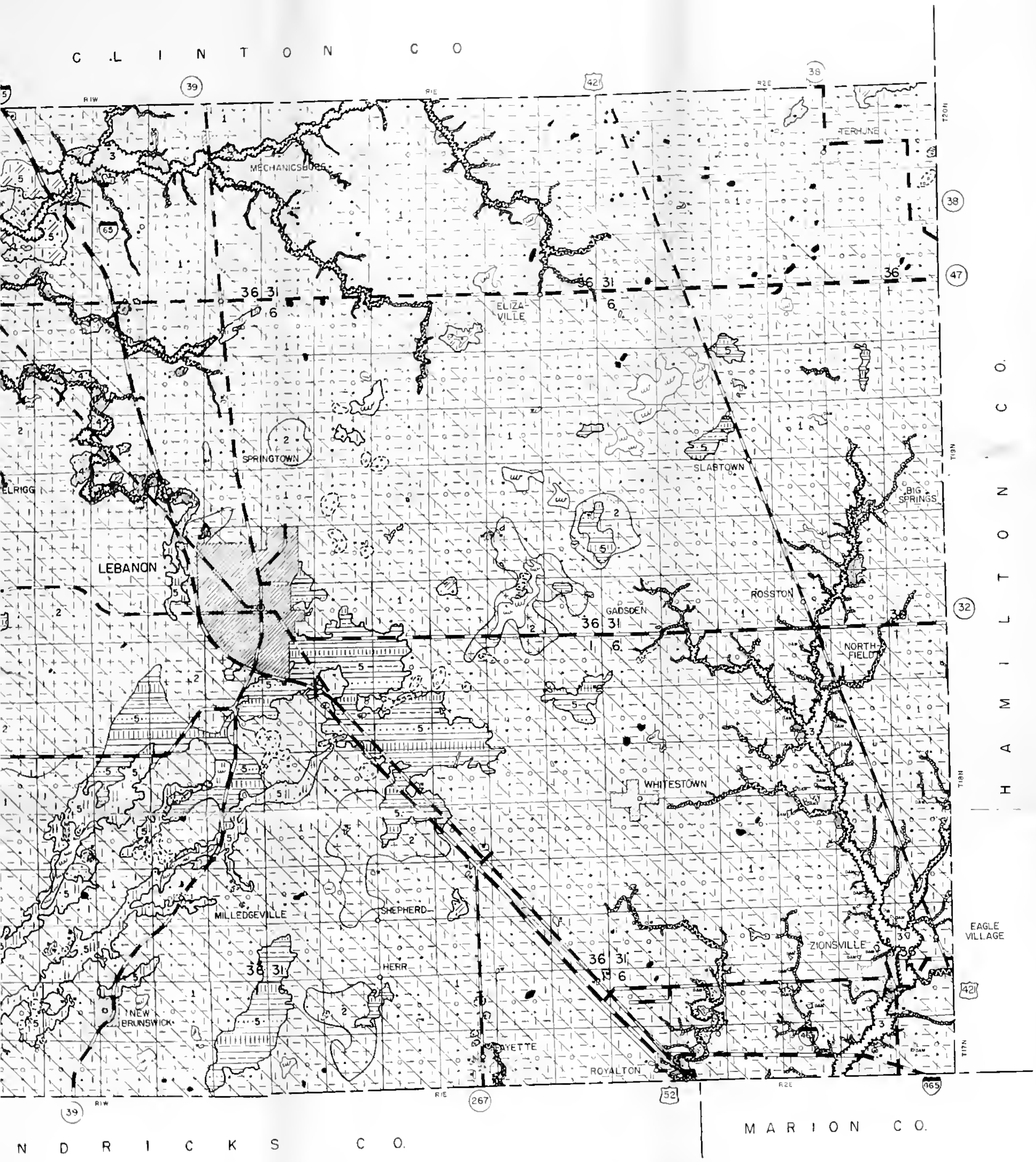
BOONE COUNTY

INDIANA

PREPARED FROM
1939 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1975

SCALE OF MILES
1 3/4 1/2 1/4 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF D. G SHURIG



LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- WISCONSIN GROUND MORAINE
- ALLUVIAL PLAIN
- VALLEY TRAIN AND GLACIAL SLUCEWAYS
- TERRACE
- OUTWASH PLAIN
- LACUSTRINE PLAIN
- ESKER OR KAME
- PEAT AND MUCK

MISCELLANEOUS

- GRAVEL PIT
  B- BORROW PIT
- HIGHLY ORGANIC TOPSOIL

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL SYMBOLS TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

TEXTURAL SYMBOLS FOR SOIL PROFILES

- GRAVEL
- SAND
- SILT
- CLAY
- LOAM

ENGINEERING SOILS MAP
BOONE COUNTY
INDIANA

PREPARED FROM

1939 AAA AERIAL PHOTOGRAPHS

BY

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AT

PURDUE UNIVERSITY

1975

SCALE OF MILES

1 3/4 1/2 1/4 0 1 2 3 4

DRAWN BY J. BUECHLER, L. FEHD, A. WISEMAN

COVER DESIGN BY ALDO GIORGINI